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# Occurrence of aflatoxin and its economic impact on human nutrition and animal feed

Mycotoxins are produced by fungi that invade field crops and contaminate agricultural commodities during postharvest storage under favourable conditions. Aflatoxin contamination continues to receive major attention, but recent interest has centered on measuring aflatoxin biomarkers such as aflatoxin-DNA adducts in human biological fluids and assessing dietary aflatoxin intake to evaluate the risk of exposure to these toxins. Current research has concentrated on different mycotoxins (fumonisins), mycotoxins affecting other commodities (ochratoxin A in coffee), and the appearance of mycotoxins in new regions (ergot alkaloids in Latin American/Australian sorghum). The focus of several surveillance programmes has shifted from single mycotoxin surveys to multi-mycotoxin surveys, particularly in cereal grains.

## Natural occurrence

Data compiled by the Global Environmental Monitoring System /Food Contamination Monitoring and Assessment Programme (GEMS/FOOD) and other national databases on mycotoxin contamination show that mycotoxins damage food supplies in most countries worldwide. Aflatoxin contamination of maize and groundnut (except refined oil), which are high-risk commodities, continues to be a major concern of surveillance programmes in various parts of the world. Contamination data is being used to estimate exposure levels for these commodities in various countries (WHO, 1998). Many studies have shown that aflatoxins are present in a broader range of foods, including various kinds of tree nuts, dry fruit, and spices. The co-occurrence of aflatoxins with other mycotoxins—particularly fumonisins—has been observed in commodities such as maize, which appears to be a common natural substrate for several mycotoxins (YOSHIZAWA *et al.*, 1996; SHETTY and BHAT, 1997).

Aflatoxin M1 contamination of milk

and milk products is being increasingly reported. A review of worldwide data since 1980 on its occurrence in human and animal milk, cheese, and other milk products seemed to indicate that common contamination levels do not represent a serious health hazard. Monitoring programmes are still the best consumer protection strategy (GALVANO *et al.*, 1996.). Recently published surveys in Germany, Greece, Poland, and UK showed that no commercial pasteurized milk and farm milk samples had aflatoxin M1 levels exceeding the European Union (EU) limit of 0.05 µg/L milk (AOAC, 1999).

## Economic impact

### Food availability

FAO has estimated the considerable impact (volume of produce affected) of mycotoxins in foodgrains in Southeast Asia (GASGA, 1993). The direct cost of the impact of aflatoxin (*Aspergillus flavus*) contamination of maize and groundnut in Thailand, Indonesia, and the Philippines was estimated to be more than \$ Aust.

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470 million per year (PITT, 1995). The effect on maize was greater (66% of the total cost). Indonesia was the worst affected country, bearing 48% of the estimated cost. Spoilage losses accounted for 24% (\$ Aust. 108 million per year).

Reports from the Australian groundnut industry showed that, for an annual production of 40 000 to 50 000 metric tonnes, with a gross annual value of \$ Aust 40 million, losses due to aflatoxin were 10% of the harvest in a good season. In poor years, more than 50% of groundnut supplies received by shellers had unacceptable aflatoxin levels. Extensive colour sorting of nuts after shelling and chemical analysis of aflatoxin levels are techniques that the Australian groundnut industry uses to obtain marketable nuts with acceptable contamination levels at a cost of at least \$ Aust 1 million per year (ACIAR, 1993).

## International trade

Mycotoxin-contaminated products cause significant economic and trade problems at almost every marketing stage, from the producer to the consumer. In recent years, exports of agricultural commodities—particularly groundnut and groundnut-based products—have been adversely affected by the stringent aflatoxin regulatory limits imposed by importing countries. In Africa, African Groundnut Council (AGC) member countries have encountered problems in exporting groundnut and its products (cake and oilseed meal) to western European markets, i.e. the main outlets for AGC products. EU has imposed regulatory limits for aflatoxin B1 in groundnut, and in feedstuffs and feedstuff ingredients that include groundnut products. Consequently, EU imports of groundnut meal have declined from

0.91 million metric tonnes in 1979/80 to 0.4 million metric tonnes in 1989/90. In India, the export value of groundnut extractions over a 10-year period is reported to have declined by US\$ 32.5 million due to aflatoxin contamination (BHAT, 1991).

Many importing countries have been establishing limits without applying the criteria recommended by the Codex Alimentarius Commission (CAC) for risk assessment and appropriate techniques to be applied. Such unreasonable regulations enforce trade barriers and are thus further increasing the scarcity of food supplies and impairing the economies of developing countries. In an attempt to harmonize the current aflatoxin tolerance levels in different countries, the Working Group on Mycotoxins of the WHO/FAO and the Codex Committee on Food Additives and Contaminants (CCFAC) proposed a maximum limit of 15 µg/kg for total aflatoxins in raw groundnuts, based on a 20 kg sample size (Codex Alimentarius Commission, 1998).

## Exposure of farm animals and economic losses

Many disease outbreaks in livestock have been caused by aflatoxin, fumonisins, trichothecenes, and zearelenone, and to a lesser extent by ochratoxin and ergot alkaloids. Even low levels of exposure to mycotoxins in feed can cause production losses. A combination of mycotoxins may lead to greater production losses than would be prompted by each of these mycotoxins separately. Economic losses can be considered in terms of reduced productivity

—lower egg production, reproductive effects, susceptibility to infections resulting in increased morbidity and finally mortality. Losses could also occur as a result of mycotoxin residue contamination of milk, eggs, meat, etc. In the past, exposure of farm animals to mycotoxins in animal feed have resulted in field outbreaks of disease. Poultry, swine, dairy cattle, and horses are the farm animals most affected by mycotoxins. The actual cost of such losses have been estimated only for some outbreaks. A case study in India of an aflatoxicosis outbreak in 11465 layers and 5000 pullets on a poultry farm revealed that an 18-day exposure to contaminated feed containing 600 µg/kg of aflatoxin B1 (mainly from groundnut cake) resulted in a loss of about 10% of the initial investment (SUDERSHAN *et al.*, 1996). The main losses were due to a drop in egg production followed by bird mortality and the additional expenditure for an alternative protein source. Medical and other miscellaneous expenditures also boosted losses.

## Conclusions

Various mycotoxins continue to be detected in different commodities worldwide. The World Trade Organization (WTO) Agreement on the application of Sanitary and Phytosanitary Measures (SPS), signed by various countries to facilitate international trade, might introduce stricter regulatory policies that could further complicate the situation for exporting countries. While rejection of export consignments of groundnut with contamination levels above the regulatory limit result in economic loss, the release of rejected consignments on domestic markets would increase the risk to consumers.





## Résumé...Abstract...Resumen

**R. V. BAHT, S. VASHANTI — Incidence de l'aflatoxine pour l'alimentation humaine et animale. Les nouvelles réglementations et leurs effets économiques.**

La contamination des produits alimentaires et des aliments du bétail par l'aflatoxine a focalisé l'attention récemment dans tous les pays, en raison de ses effets nocifs sur la santé humaine et animale, et de ses conséquences sur les économies nationales. Les programmes de surveillance s'orientent désormais vers des enquêtes portant sur des mycotoxines multiples, dans les céréales en particulier. La présence simultanée d'aflatoxine et d'autres mycotoxines comme la fumonisine est signalée dans divers pays. L'incidence économique de la contamination par l'aflatoxine sur l'industrie des graines alimentaires et des produits d'élevage est considérable. Des pertes importantes ont été relevées, en particulier dans la transformation industrielle de l'arachide. Les productions avicole et porcine ont été affectées par l'aflatoxine, la fumonisine et la zéaralénone. En conséquence, l'exportation de produits agricoles, et en particulier de produits arachidiers, provenant de pays en développement a subi une baisse considérable ces dernières années, occasionnant des pertes économiques importantes pour les pays producteurs.

**Mots-clés :** mycotoxine, aflatoxine, santé humaine, alimentation animale, arachide, perte économique, exportation, zone tropicale, Europe.

**R. V. BHAT, S. VASANTHI — Occurrence of aflatoxin and its economic impact on human nutrition and animal feed. The new regulations.**

Mycotoxin contamination of foods and feeds has recently gained much attention worldwide due to its adverse effects on human and animal health, and consequent national economic implications. The focus of surveillance programmes has shifted to multi-mycotoxin surveys, particularly with respect to cereal grains. Reports from various countries have highlighted the co-occurrence of aflatoxin with other mycotoxins such as fumonisin. Mycotoxin contamination has had a considerable economic impact on the foodgrain and livestock industry. Major losses have been reported in the groundnut industry. Poultry and swine production have been affected by mycotoxins such as aflatoxin, fumonisin, and zearalenone. Exports of agricultural commodities—particularly groundnut and its products— from developing countries have thus dropped considerably in recent years, resulting in major economic losses for producing countries.

**Keywords:** mycotoxin, aflatoxin, human health, human nutrition, groundnut, economic loss, exportation, Tropics, Europe.

**R. V. BAHT, S. VASHANTI — Incidencia de la aflatoxina e impacto económico en la nutrición humana y la alimentación animal. Las nuevas reglamentaciones.**

La contaminación de productos alimenticios y de los alimentos del ganado por la aflatoxina ha centrado la atención recientemente en todos los países, debido a sus efectos nocivos para la salud humana y animal y las consecuencias sobre las economías nacionales. Los programas de vigilancia dirigen actualmente sus esfuerzos hacia estudios sobre las micotoxinas múltiples, particularmente en los cereales. Se ha detectado en varios países la presencia simultánea de aflatoxinas y de otras micotoxinas como la fumonisina. La incidencia económica de la contaminación por aflatoxina en la industria de semillas alimentarias y de productos de ganadería es considerable. Se observaron pérdidas especialmente importantes en la transformación industrial del maní. Las producciones avícola y porcina se han visto afectadas por la aflatoxina, la fumonisina y la zearalenona. Por ello, la exportación de productos agrícolas, particularmente maní y derivados, procedentes de países en desarrollo ha sufrido una disminución considerable durante estos últimos años, causando importantes pérdidas económicas a los países productores.

**Palabras claves:** micotoxina, aflatoxina, salud humana, alimentación animal, maní, pérdida económica, exportación, zona tropical, Europa.